

Proposal

African Strategy for Fundamental and Applied Physics (ASFAP)

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1. Preamble

The ASFAP has a vision that Africa is an ideal location for a global research infrastructure (RI). This is a vision and a dream, and even if it's not immediately realisable, it is very important for Africa as a continent to seriously consider its commitment to this option. It is equally important that the rest of the world also seriously consider this option. It is not without precedent in that the largest astronomical global research infrastructure is located in Africa, and is developing very successfully and on schedule. Its early installed equipment has seen major innovation in design and construction from Africa, as well as investment from Africa. Africa is now seriously considering an advanced Light Source for the continent, the AfLS. From an African point of view, Africa would gain far more if the RI would be in Africa, and it would also be more accessible to Africa. It is fully accepted that there are tremendous socio-economic benefits for the RI to be in Africa. The return on investment is well established. We believe that Africa can afford to participate at this level, and it's simply a matter of political will. We now examine some considerations of this vision. Africa is an excellent location in terms of centrality, available space, international accessibility, affordability and alignment with the vision for Science as a global endeavour. Placing the RI facility in Africa would endow the greatest impact on capacity

development possible, also the greatest impact on diversity and inclusivity. A RI is known to be extremely significant for Science Diplomacy, and here the African location would be the most appropriate. A drawback could be security of energy supply, but wherever such an infrastructure is, it should have its own power station. So this point is completely moot. Another drawback could be local technological capacity. However, the new machine will have international staffing. Also the history of Sirius in Brazil, and similar for many other such facilities has shown that this obstacle is removed already in the short term very spectacularly.

2. Introduction

Considering scarce resources, it is important for the world community of scientists, engineers, technicians, funding agencies and policymakers to come together and define a concerted strategy. Such efforts have been or are currently conducted in other regions. Recently, Europe updated its strategies (Update of the European Strategy for Particle Physics, CERN-ESU-013, June 2020) taking into account inputs from the international community. At the time of writing this proposal, the United States of America and Latin America are developing their strategies. To arrive at the definition of a strategy, many inputs from the regional community are collected in the form of proposals, letters of intent and white papers, welcoming input from the world community as well, and then discussed and debated in plenary sessions and topical parallel sessions. It is a process that may take many months and culminate into a report—to advise the scientific community, funding agencies and policymakers on strategic directions to improve research and education. The process to define an African strategy is a true spirit of international cooperation that forms the common denominator of today's culture of our scientific activities, defining priorities for domestic and inter-regional projects to be supported.

Fundamental and applied physics draws on worldwide efforts with a small yet steadily increasing presence of developing countries from Asia, South America and Africa. While we can be proud of African countries such as Morocco, Egypt and South Africa gaining footholds in major international projects at the Large Hadron Collider, the cooperation among African countries and between them and the rest of the world is not well developed. This is especially the case for sub-Saharan Africa, which is one of the most rapidly developing regions in the world with great educational needs. In order to extend—or augment—the existing international scientific ties to

this continent, in the development of the strategic visions for fundamental and applied physics, engagement in physics education, communication and outreach, toward developing countries, should be strengthened and sustained also in targeted programs toward Africa. The success of these targeted programs would be sufficiently encouraging to provide motivation for a review of goals and for consideration of mechanisms of sustainability. The central long-term objective—to be integrated in the development of strategic visions for science and technology—would be to help improve higher education in Africa across national borders and in so doing, to contribute in a significant way to the development on this continent. We believe that maintaining the leadership of the organization of targeted education programs in Africa, in partnership with other interested institutes and African governments and policy makers, presents a unique opportunity for the international community to pioneer the scientific and technological development of a region of more than a billion people with large unmet needs but vast human potential.

Africa, a rich continent in natural resources, is still lagging behind in innovation, transfer of knowledge, mass education, and its economies are not growing as expected to meet the needs of its fast-increasing populations. The African youth represents more than 70% of the population, and is, very often, unskilled, unemployable, falls back into poverty, and struggles to cope. Africa further faces the issue of the retention of its qualified young people.

However, African initiatives promoted by African countries with their own resources—in some cases in partnerships with international institutes—are numerous. Among them in our field, to name a few, we cite the East Africa Institute for Fundamental Research (EAIFR), the Egyptian Network of High Energy Physics, the similar one, RUPHE, in Morocco, the excellent infrastructure of HESS experiment in Namibia, not to forget the prestigious universities in South Africa and its high-level research laboratories.

To help address the aforementioned issues effectively, we believe that African educational and research institutes should develop their own strategic discussions and planning of fundamental and applied physics, for the short, medium and long terms. We feel that Africans, developing their own strategy for science and technology, will have major benefits. This would allow the international partners interested in capacity development and retention in Africa to integrate inputs from Africans themselves, rather than to default to their own views of how they may want

to “help” Africans. In addition, the help—in whichever form it is delivered—will have more impact. In addition, the process to define an African strategy will bring together the African scientific communities and more pan-African scientific collaborations may emerge. Furthermore, we hope that the African strategy will help to inform African policymakers.

The African strategy for fundamental and applied physics further fosters social transformation and economic competitiveness, through human capital development and innovation—Africa having the capacity to use science for the benefit of its people. It is therefore vital for Africans to contribute to long-term sustainable training in Africa that can only be ensured through committed investments in research and development (R&D) with African-led local and international partnerships. International cooperation is a large common denominator of the culture of scientific activities. However, in many scientific disciplines and especially in the field of Fundamental and Applied Physics, the cooperation among African countries and between them and non-African countries is not sufficiently developed. In addition, there is a lack of skilled curriculum developers, insufficient resources for effective implementation, persistent shortages of trained science researchers, and ineffective planning. Hence, the related scientific disciplines should be gathered through a coherent program by establishing a strong connection between the network of academic institutions and the associated partners, including the private sectors.

Scientific competence and understanding is required to increase the numbers of professionals. It is therefore timely and strategically important to undertake a strategy that could help. Since the scientific research in Africa includes the development of human resources, it is critical to ascertain what macro policy perspectives frame decisions on its nature. We must mobilize and include the involvement of the relevant policymakers of the African science research and education, to develop strategies and participate in Africa’s science and technology projects. Africa must harvest its population demographic dividend, especially the women and youth, whose energy, creativity and courage must drive its continental development strategy.

In pursuing this vision, the African scientific communities emphasize the importance of building synergy between fundamental physics and practical applications which is crucial for a solid

education in Africa. Investments in education, technical competences and training, and in science, technology, research and innovation remain critical.

In this proposal, we outline the needed steps to initiate ASFAP.

3. Structural Organization

We propose the formation of a Steering Committee (STC) made of professional scientists that are still active in their fields and well-connected to the international community. Members of the STC shall be Africans (from Africa and the diaspora). The Steering Committee will manage and lead the work until the final report that will serve as the African Strategy.

a. Founding members of the Steering Committee (STC)

- Dr. Kétévi A. Assamagan, Physicist at Brookhaven National Laboratory, USA & Fellow of the African Academy of Science. Email: ketevi@bnl.gov;
- Dr. Simon H. Connell, Professor of Physics at the University of Johannesburg, South Africa & Fellow of the African Academy of Science. Email: si@mykonos.org.za;
- Dr. Farida Fassi, Professor of Physics at Mohammed V University, Morocco. Email: Farida.Fassi@cern.ch;
- Dr. Shaaban Khalil, Professor of Physics at the Center for Fundamental Physics, Zewail City, Egypt & Fellow of the African Academy of Science. skhalil@zewailcity.edu.eg;
- Dr. Fairouz Malek, Physicist, Research Director at CNRS, Laboratoire de Physique Subatomique et de Cosmologie de Grenoble, France. Email: fmalek@lpsc.in2p3.fr.

The ASFAP Founding Process is designed to be a transparent and democratic process, to be owned by Africans for Africa. It has to be initiated by someone, and as such, we have initiated the process. Our pedigree derives from a long history of work in the area of Fundamental Physics and Applications, but particularly from more than a decade of work through the African School of Fundamental Physics and its applications, which has led to a large community with a common vision for Africa, as well as all the appropriate networks for us to guide and nurture this process. The vision is that Africa should take its equal place as a co-leader in the global scientific process, along with all the social-economic benefits thereto. As we formed the structures of the ASFAP, according to international best practice, and adapted for Africa considering the emphasis on the

spin-off benefits from Fundamental Physics, into many associated disciplines, which lead us to have a broad convener structure. As these structures are populated, they evolve to become increasingly inclusive and to exhibit transparency and democracy, as we reach out to the full community and involve them. At the maturity of this process, the leadership of the ASFAP will also be re-established through elections to reflect the wishes and industry of the institutions and the individuals of the African community who have become involved. We also see as African, all who seek to promote this vision for Africa. As such, this process is characterised by the African spirit of Ubuntu. We have every expectation it will grow into a healthy vibrant and robust Strategy.

The STC may be extended with additional members, considering geographical balance, male-to-female ratio, and representations of various scientific fields in the steering committee.

The STC will elect a Chair or Spokesperson among its rank.

b. The International Advisory Committee (IAC)

An International Advisory Committee (IAC) will advise the Steering Committee. Members of the IAC shall be from the worldwide community. The role of the IAC will be to offer perspectives from their own strategies to inform the STC who will be responsible to make decisions toward a successful strategy. The suggested members of the IAC are: **Prof. Ahmadou Wagué** (President of the African Physical Society), **Prof. Atish Dabholkar** (Director of ICTP), **Prof. Faïçal Azaiez** (Director of iThemba LABS, South Africa), **HE Dr. Bonginkosi Emmanuel "Blade" Nzimande** (Honorable Minister of Higher Education, Science and Technology, South Africa), **Prof. Dr. Joachim Mnich** (Director in Charge of Particle Physics at DESY, and future Director for Research and Computing at CERN), **Dr. Fadila Boughanemi** (EU Deputy Head of International Cooperation, Research and Innovation Unit), **Prof. Fernando Quevedo** (Former Director of ICTP), **HE Prof. Kwabena Frimpong-Boateng** (Honorable Minister for Environment, Science, Technology and Innovation, Ghana), **Prof. James S. Gates** (Brown University, President Elect of APS), **Prof. Jie Zhang** (Chair Professor, Academician of Chinese Academy of Science, School of Physics and Astronomy, Shanghai Jiao Tong University, China), **Dr. Latifa Elouadrhiri** (Physicist Jefferson Lab & DOE, USA), **Prof. Mahmoud Sakr** (President of Egyptian Academy of Scientific Research and Technology, Egypt), **Prof. Michel Spiro** (President of IUPAP), **Dr. Najat Mokhtar** (IAEA Deputy Director

General and head of the Department of Nuclear Sciences and Applications), **Prof. Petra Rudolf** (University of Groningen, The Netherlands, President of EPS), **Prof. Rob Adam** (Director of SKA South Africa), **Prof. Rohini Godbole** (India Institute of Science), **Prof. Rolf Heuer** (President of the SESAME Council), **Dr. Setsuko Tajima** (President Elect of the Japan Physical Society, Osaka University), **Dr. Shamila Nair-Bedouelle** (UNESCO Assistant Director-General for Natural Sciences), **Prof. Zblon Vilakazi** (Vice Chancellor, University of the Witwatersrand, South Africa).

The STC will define working groups related to the different fields of fundamental and applied physics and seek Working the Group Conveners (WGC). The ASC will select 2-3 individuals as the conveners of each working group. The working group conveners will define sub-groups or topical groups to cover all the areas within their specific scientific domains, and nominate 2-3 sub-group conveners. The topical group and sub-group conveners will be reviewed and approved by the STC. Working group and subgroup conveners will seek people, in Africa and abroad, interested to work on the topics within their mandates.

4. Scope

As fundamental and applied physics, we propose to form working groups in these related areas:

- A. Particle Physics;
- B. Nuclear Physics;
- C. Accelerators;
- D. Medical Physics;
- E. Light Sources;
- F. Instrumentation & Detectors;
- G. Astrophysics & Cosmology;
- H. Computing & 4IR;
- I. Community Engagement.

When the ASC identifies the working group conveners, then together they will define the subgroups of each group.

5. Meetings

The IAC, STC, working groups and sub-groups may arrange meetings as often as necessary. The process will end with a symposium during which the major findings to go into the final report of the strategy will be presented.

6. Support

We seek the support from the African Academy of Science (AAS), the African Physical Society and the broader physics community.

7. Host Institute

We suggest that a pan-African educational and/or research institute serves as the host of the activities on the development of the strategy. The host institute will help with the work to be done (formation of emailing lists of groups and sub-groups, meeting agenda platform, Twiki pages, recordings and savings of working documents in progress, etc.), organize and host the final symposium. The host institute may seek funding or grant for this assistance. We suggest the African Physical Society (AfPS) as a potential host.

8. Timeline

The work will start as soon as the working groups are formed. The authors of this proposal, with support from AAS and the African Physical Society, will establish the structural organization mentioned in Section 2. When this is done, a kickoff meeting will be organized by the STC. Calls for proposals, letters of intent and/or white papers will be announced and encouraged. The STC and the host institute will agree on the date of the final symposium. We suggest that the final symposium takes place during the 2022 edition of ASP in South Africa. Tentative milestones and deliverables of the project, as well as the activities are summarised in the next table.

Time	Action
October - December 2020	First meeting with IAC and group conveners Invitation to stakeholders
January - March 2021	Definition of subgroups of each working group Consultation with the IAC / stakeholders Call for nominations of subgroup conveners
April - June 2021	Selections of subgroup conveners Start of regular group meetings Africa-wide town hall
July - September 2021	Call for Letters of Intent (LoI) From LOIs to White Paper study groups
October - December 2021	Community planning meeting White paper studies in progress Outline of the Strategy report
January - March 2022	Group contributions to the report Preliminary draft of report Consultation with IAC & Stakeholders / IAC & Stakeholders feedback
April - June 2022	White paper study groups finalized Report matured Community feedback
July - September 2022	ASFAP symposium Community feedback
October - December 2022	Final report endorsed by the AfPS Executive Committee and IAC Report submitted to the African Academy of Sciences and other Stakeholders in Africa, and distributed widely Strategy ends — to be repeated 5-7 years later

9. Final Report

After the symposium, the STC, working with the group conveners, will produce, within 3 months, the final report on the African Strategy. The IAC will endorse the report before it is published and distributed widely.